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GEOS-5 Chemistry Transport Model User's Guide

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GEOS-5 Chemistry Transport Model User's Guide

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Approved by:

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REVISION HISTORY

Version	Revision Date	Extent of Changes
1.0	09/04/2015	Baseline

Abstract:

The Goddard Earth Observing System version 5 (GEOS-5) General Circulation Model (GCM) makes use of the Earth System Modeling Framework (ESMF) to enable model configurations with many functions. One of the options of the GEOS-5 GCM is the GEOS-5 Chemistry Transport Model (GEOS-5 CTM), which is an offline simulation of chemistry and constituent transport driven by a specified meteorology and other model output fields. This document describes the basic components of the GEOS-5 CTM, and is a user's guide on to how to obtain and run simulations on the NCCS *Discover* platform. In addition, we provide information on how to change the model configuration input files to meet users' needs.

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1 Background

The GEOS-5 Chemistry Transport Model (CTM) integrates one configurable CTM with options for running any chemistry module currently available within the GEOS-5 GCM code base. It uses the GEOS-5 Earth System Modeling Framework (ESMF) infrastructure (MAPL, the "History" component and the "ExtData" component) and the GEOS-5 advection component (AdvCore) to drive the GEOS-5 Chemistry component (that includes options for the Global Modeling Initiative (GMI) [Logan et al., 2003], the Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) [Chin et al., 2000], GEOS-Chem [Bey et al., 2001], etc.). Detailed information about the GEOS-5 CTM is available in [Kouatchou et al., 2015].
The main components of GEOS-5 CTM are:

AdvCore : the transport componet which source code is part of the GEOS-5 directory *FVdycore-Cubed_GridComp/*.

Chemistry : the GEOS-5 Chemistry component which contains all the options for chemistry models available in GEOS-5 GCM, such as GOCART, GMI, GEOS-Chem, etc. The entire GEOS-5 *GEOSchem_GridComp/* defines this component.

Diffusion : component where various diffusion methods are implemented.

Convection : component where various convection methods are implemented.

GEOS-5 CTM Cinderella : a component which primary role is to provide services to the other components. For instance, it will compute the courant numbers and mass fluxes (using the winds and pressure) for AdvCore.

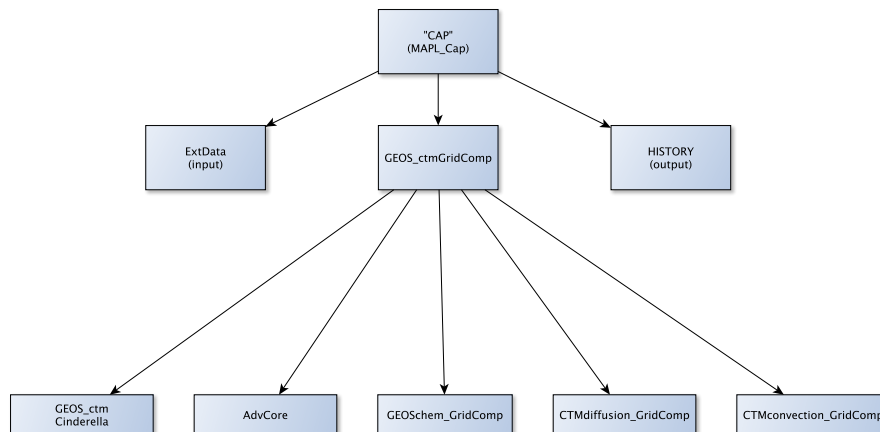They are shown in Figure 1.

Figure 1: Flow diagram of the main components of GEOS-5 CTM.

2 Obtaining the Code

It is assumed that we have access to the GEOS-5 CVS repository and that we have the settings:

```
setenv CVS_RSH ssh
setenv CVSROOT :ext:userID@progressdirect.nccs.nasa.gov:/cvsroot/esma
```

where *userID* is our NCCS username.

The latest version of GEOS-5 CTM (as of August 2015) is under the tag name:

<div align="center">Heracles-3_1_CTM</div>

To obtain the code, use the cvs command:

<div align="center">*cvs co -r Heracles-3_1_CTM GEOSctm*</div>

We will then get the directory *GEOSctm/*. The basic directory structure of the code is:

```
src/
src/Config/
src/GMAO_Shared/
src/Applications/
src/Applications/GEOSctm_App
src/GEOSctm_GridComp/
src/GEOSctm_GridComp/CTMconvection_GridComp/
src/GEOSctm_GridComp/CTMdiffusion_GridComp/
src/GEOSctm_GridComp/CTMpTracers_GridComp/
src/GEOSctm_GridComp/FVdycoreCubed_GridComp/
src/GEOSctm_GridComp/GEOSchem_GridComp/
```

The GEOS-5 CTM Cinderella component (used to derived variables) is included in the file:

```
src/GEOSctm_GridComp/GEOS_ctmEnvGridComp.F90
```

3 Compiling the code

To compile the code, go to the directory:

<div align="center">*GEOSctm/src/*</div>

and issue the command (that does a parallel compilation):

<div align="center">*./parallel_build.csh*</div>

(we should be ready to provide our sponsor code account). The executable, *GEOSctm.x*, will be in the directory:

<div align="center">*GEOSctm/Linux/bin*</div>

4 Running the Code

In order to run GEOS-5 CTM, a "setup" script is available with a suite of default configurations. Go to the directory *GEOSctm/src/Applications/GEOSctm_App/* and run the script:

<div align="center">*./ctm_setup*</div>

We will answer a series of questions to determine the model configuration (horizontal resolution, type of Chemistry, driving dataset, etc.) we are interested in. Table 1 shows the possible configuration options.

The script will automatically generate configuration files and run scripts. In our experiment directory, it will create:

Chemistry	Passive Tracer, pChem, GOCART, GMI, GOCART_Data
Driving Dataset	MERRA, FP, FP-IT, MERRA2
Horizontal Resolution (deg)	2, 1, 1/2, 1/4, 1/8, 1/16

Table 1: Configuration options of GEOS-5 CTM.

```
CAP.rc:            file containing information on start date & time,
                   end date & time of job segment, duration of job
                   segment, stop date & time of entire experiment.
HISTORY.rc:        file for selecting the type of diagnostics to be produced
ctm_run.j:         SLURM script for submitting the job
RC/                contains all the resource files needed to drive the model
CTM_GridComp.rc:   file for turning on/off Convection, Diffusion
                   and for selecting the type of meteorological
                   driving (MERRA or MERRA2)
GEOSCTM.rc:        file for setting model parameters
MAPL_ExtData.rc    file needed by ExtData to read external data files
```

Before submitting, create the file:

```
cap_restart:       ASCII file containing (single line) starting the
                   date (YYYYMMDD) and time (HHMMSS) of the job segment
                   in the format: YYYYMMDD HHMMSS
```

and then issue the command:

$$qsub\ ctm\_run.j$$

At run time, the following directories will be created:

```
holding/:          location where output files are moved to after a
                   successful run.
restart/:          location of restart files generated by the model
scratch/:          temporary directory used to keep necessary files
                   while the code is running
```

Remark 1 *If we choose to use MERRA2 driving datasets (default option), the* ctm_setup *script will generate the file* MERRA2_ExtData.rc.tmpl *instead of* MAPL_ExtData.rc. *At run time, the SLURM script* ctm_run.j *manipulates* MERRA2_ExtData.rc.tmpl *to create a file similar to* MAPL_ExtData.rc.

5 Changing Default Configuration

5.1 CTM_GridComp.rc File

The *CTM_GridComp.rc* file is used to set options for Convection, Diffusion and the type meteorological data.

Meteorological Data

We need to set the variable *metType* that has two options: *MERRA2* (default, can also be used for FP-IT data) and *MERRA* (for MERRA data).

Convection

By default, Convection is activated for GMI and not for other configurations. In case we want to exercise Convection for non-GMI experiments, we need to set:

```
do_ctmConvection: T
      convecType: 1  # convective transport only
```

Diffusion

By default, Duffusion is activated all configurations but Passive Tracer. In case we want to exercise Diffusion, we need to set:

```
do_ctmDiffusion: T
```

5.2 Duration of Experiment

In the process of generating the configuration scripts, the following files were created:

- *CAP.rc*: contains begin/end date and time of entire job, stop date, duration (in days) of each job segment.

- *ctm_run.j*: SLURM script

- *cap_restart*: contains two numbers pointing to the starting date YYYYMMDD and starting hour HHMMSS of the job.

Assume that we want to carry out a 12-month experiment with January 1, 2005 as starting date. We want to run one month at the time. The file *cap_restart* will have

```
20050101 000000
```

and the file *CAP.rc* will have the settings:

```
BEG_DATE:      20000101 000000
END_DATE:      20060101 000000
JOB_SGMT:      00000031 000000
```

Note that the stop date **END_DATE** is January 1, 2006. We will need to submit the PBS script:

$$qsub\ ctm\_run.j$$

When the first job segment is completed (for January 2005), the script will resubmit itself. The file *cap_restart* will automatically be updated to contain

```
20050201 000000
```

5.3 ExtData Component

GEOS-5 contains the Gridded Component *ExtData* that has the ability to read from external files variables needed by the model. *ExtData*

- Relies on a resource file that lists the variables to be read in. Each variable is represented with the following information: short name, dimension, unit, path to netCDF/hdf file containing the variable, variable name in the file, reading frequency, etc.

- Can perform unit conversion. It has basic scaling and offset calculations.

- Does time interpolation.

- Does regridding.

- Is called at every time step before all the other run methods (Physics, Dynamics).

- Is the last ESMF gridded component the entire code will rely on to look for the availability of a given variable (requested by another ESMF gridded component). If the variable cannot be provided, the code will abort.

Create/Edit the file MAPL_ExtData.rc:

This resource file (to be located in the running directory) is read by the *ExtData* component and should contain information on the variables to be extracted from the files.

```
PrimaryExports::
# ---------|--------------|-----|-----|------|---------------------|--------|-------|------------------------------
# Export   |              |     | V   |      |_____ Refresh _____|___ Factors ___|_____ External File _____
# Name     |    Units     | Dim | Loc | Clim |   Time Template      | Offset | Scale | Variable |    Template
# ---------|--------------|-----|-----|------|---------------------|--------|-------|----------|---------------------

ZPBL            'm'          xy    C     N           N    0          0.0      1.0     PBLH      MERRA2_400.tavg1_2d_flx_Nx.%y4%m2%d2.nc4
FRLAND          '1'          xy    C     Y           N    0          0.0      1.0     FRLAND    MERRA2_400.const_2d_asm_Nx.climatology.nc4
T               'K'          xyz   C     N           N    0          0.0      1.0     T         MERRA2_400.inst3_3d_asm_Nv.%y4%m2%d2.nc4
PLE             'Pa'         xyz   E     N           N    0          0.0      1.0     PLE       MERRA2_400.tavg3_3d_nav_Ne.%y4%m2%d2.nc4
```

where:

Export Name: The variable name as written in Import State declaration.

Units: The unit of the variable.

Dim: Variable dimension (xy or xyz)

V Loc: Can have either 'C' (center) of 'E' (edge).

Clim: Determine if the reading will be cyclic (Y) or not (N).

Factors: Offset and Scale for unit vonversion.

External File: The variable name as it appears in the file and the location where the external file resides.

5.4 Ouputting Variables

Component Names

To produce a field by the HISTORY component, it is important to know the acronym of the component which owns it. Table 2 lists the main component names and their acronyms.

HISTORY Settings

The contents of the the file HISTORY.rc tell the model what and how to output its state and diagnostic fields. To learn the proper settings in HISTORY.rc, visit the website:

http://geos5.org/wiki/index.php?title=Ganymed_4.1_User's_Guide#Determining_Output:_HISTORY.rc

Long Name	Name in **HISTORY.rc**
GEOS-5 CTM Cinderella	CTMenv
GEOSchem Cinderella	CHEMENV
Passive Tracer	TR
GOCART	GOCART
GMI	GMICHEM
Convection	CONVECTION
Diffusion	DIFFUSION

Table 2: Component Names and Acronymes Used in HISTORY.rc.

Bibliography

[Bey et al., 2001] Bey, I., Jacob, D. J., M.Yantosca, R., Logan, J. A., Filed, B. D., Fiore, A. M., Li, Q., Liu, H. Y., Mickley, L. J., and Schiltz, M. G. (2001). Global modeling of tropospheric chemistry with assimilated meteorology: Model description and evaluation,. *J. Geophys. Res.*, 106:23073–23095.

[Chin et al., 2000] Chin, M., Rood, R. B., Lin, S.-J., Muller, J., and Thompson, A. (2000). Atmospheric sulfur cycle simulated in the global model GOCART: model description and global properties. *J. Geophys. Res.*, 105:24671–24687.

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[Logan et al., 2003] Logan, J. A., Bergmann, D., Rodriguez, J., Chatfield, R., Considine, D., Wang, Y., Jacob, D., Prather, M., Rotman, D., and Cameron-Smith, P. (2003). Evaluation of tropospheric chemistry simulations for the Global Modeling Initiative (GMI). *Geophysical Research Abstracts*, 5.

Appendix A: Meteorological Fields for GMI

Below is a the list of typical meteorological related variables required to run the GMI configuration.

```
-----------------------------------------------------------------------
Short Name  Long Name                                           Unit
-----------------------------------------------------------------------
AIRDENS     air density                                         kg m-3
ALBVF       surface albedo for visible diffuse                  1
ASNOW       fractional area of land snowcover                   1
CLDTT       total cloud area fraction                           1
CN_PRCP     convective precipitation                            kg m-2 s-1
CNV_MFC     cumulative mass flux                                kg m-2 s-1
CNV_MFD     detraining mass flux                                kg m-2 s-1
DFPAR       surface downwelling par diffuse flux                W m-2
DQDT        specific humidity tendency due to moist             s-1
DRPAR       surface downwelling par beam flux                   W m-2
FCLD        cloud fraction for radiation                        1
FRACI       ice covered fraction of tile                        1
FRLAKE      fraction of lake                                    1
FRLAND      fraction of land                                    1
FRLANDICE   fracrion of land-ice                                1
GRN         greeness fraction                                   1
LAI         leaf area index                                     1
LFR         lightning flash rate                                km-2 s-1
LWI         land-ocean-ice mask                                 1
PFL_CN      3D flux of liquid convective precipitation          kg m-2 s-1
PFL_LSAN    3D flux of liquid non convective precipitation      kg m-2 s-1
PLE         air pressure                                        Pa
PS          surface pressure                                    Pa
Q           specific humidity                                   1
QL          cloud liquid for radiation                          1
RH2         relative humidity after moist                       1
SWNDSRF     surface net downward shortwave flux                 W m-2
T           temperature                                         K
T2M         2-meter air temperature                             K
TA          surface air temperature                             K
TAUCLW      optical thickness for liquid clouds                 1
TAUCLI      optical thickness for ice clouds                    1
TPREC       total precipitation                                 kg m-2 s-1
TROPP       tropopause pressure based on blended estimate       Pa
U           eastward wind                                       m s-1
U10M        10-meter eastward wind                              m s-1
USTAR       surface velocity scale                              m s-1
V           northward wind                                      m s-1
V10M        10-meter northward wind                             m s-1
WET1        surface soil wetness                                1
Z0H         surface roughness for heat                          m
ZPBL        Planetary boundary layer height                     m
ZLE         geopotential height                                 m
-----------------------------------------------------------------------
```

Appendix B: Using the GEOS-5 CTM CC for Producing Diagnostics

The GEOS-5 CTM Cinderella component (CC) can be used to produce diagnostics variables. Users may want the model to output meteorological fields (that are in external data files) at the same

resolution as that of the other diagnostics. Simple code modifications can be done in CC to achieve it. Assume that we want to write out specific humidity. The following changes will be introduced in CC:

```
SetServices
-----------
      call MAPL_AddImportSpec(GC,                                    &
           SHORT_NAME = 'Q',                                         &
           LONG_NAME  = 'specific_humidity',                         &
           UNITS      = 'kg kg-1',                                   &
           DIMS       = MAPL_DimsHorzVert,                           &
           VLOCATION  = MAPL_VLocationCenter,          RC=STATUS  )
      VERIFY_(STATUS)

      call MAPL_AddExportSpec(GC,                                    &
           SHORT_NAME = 'Q',                                         &
           LONG_NAME  = 'specific_humidity',                         &
           UNITS      = 'kg kg-1',                                   &
           DIMS       = MAPL_DimsHorzVert,                           &
           VLOCATION  = MAPL_VLocationCenter,          RC=STATUS  )
      VERIFY_(STATUS)

RUN
---
      real, pointer, dimension(:,:,:) :: imQ => null()
      real, pointer, dimension(:,:,:) :: exQ => null()

      call MAPL_GetPointer ( IMPORT, imQ,  'Q', __RC__ )
      call MAPL_GetPointer ( IMPORT, exQ,  'Q', __RC__ )
      exQ = imQ
```

In the HISTORY.rc file, we will need the setting:

```
      'Q'             , 'CTMenv'  ,
```

Appendix C: Export State Variables

We provide a list of fields that can be produced by the HISTORY component. They are export state variables of existing components.

3.1 pCHEM

Name	Component	Units	Dim	Long Name
OX_TEND	PChem	-->	xyz	tendency of odd oxygen mixing ratio due to chemistry [mol mol-1 s-1]
H2O_TEND	PChem	-->	xyz	tendency of water vapor mixing ratio due to chemistry [kg kg-1 s-1]
OX_PROD	PChem	-->	xyz	tendency of odd oxygen volume mixing ratio due to production [mol mol-1 s-1]
OX_LOSS	PChem	-->	xyz	tendency of odd oxygen volume mixing ratio due to loss [mol mol-1 s-1]
N2O_PROD	PChem	-->	xyz	tendency of nitrous oxide volume mixing ratio due to production [mol mol-1 s-1]
N2O_LOSS	PChem	-->	xyz	tendency of nitrous oxide volume mixing ratio due to loss [mol mol-1 s-1]
CFC11_PROD	PChem	-->	xyz	tendency of CFC11 volume mixing ratio due to production [mol mol-1 s-1]
CFC11_LOSS	PChem	-->	xyz	tendency of CFC11 volume mixing ratio due to loss [mol mol-1 s-1]
CFC12_PROD	PChem	-->	xyz	tendency of CFC12 volume mixing ratio due to production [mol mol-1 s-1]
CFC12_LOSS	PChem	-->	xyz	tendency of CFC12 volume mixing ratio due to loss [mol mol-1 s-1]
HCFC22_PROD	PChem	-->	xyz	tendency of HCFC22 volume mixing ratio due to production [mol mol-1 s-1]
HCFC22_LOSS	PChem	-->	xyz	tendency of HCFC22 volume mixing ratio due to loss [mol mol-1 s-1]
CH4_PROD	PChem	-->	xyz	tendency of methane volume mixing ratio due to production [mol mol-1 s-1]
CH4_LOSS	PChem	-->	xyz	tendency of methane volume mixing ratio due to loss [mol mol-1 s-1]
H2O_PROD	PChem	s-1	xyz	tendency of specific humidity due to production
H2O_LOSS	PChem	s-1	xyz	tendency of specific humidity due to loss
O3	PChem	kg kg-1	xyz	ozone mass mixing ratio
O3PPMV	PChem	ppmv	xyz	ozone volume mixing ratio
TO3	PChem	Dobsons	xy	total column ozone
TTO3	PChem	Dobsons	xy	tropospheric column ozone

3.2 GMI

Name	Component	Units	Dim	Long Name
GMICHEMBCphobic	GMICHEM	kg kg-1	xyz	prescribed hydrophobic black carbon from GMICHEM
GMICHEMBCphilic	GMICHEM	kg kg-1	xyz	prescribed hydrophylic black carbon from GMICHEM
GMICHEMdu001	GMICHEM	kg kg-1	xyz	prescribed dust bin 1 from GMICHEM

Name	Source	Units	Dims	Description
GMICHEMdu002	GMICHEM	kg kg-1	xyz	prescribed dust bin 2 from GMICHEM
GMICHEMdu003	GMICHEM	kg kg-1	xyz	prescribed dust bin 3 from GMICHEM
GMICHEMdu004	GMICHEM	kg kg-1	xyz	prescribed dust bin 4 from GMICHEM
GMICHEMOCphobic	GMICHEM	kg kg-1	xyz	prescribed hydrophobic organic carbon from GMICHEM
GMICHEMOCphilic	GMICHEM	kg kg-1	xyz	prescribed hydrophylic organic carbon from GMICHEM
GMICHEMss001	GMICHEM	kg kg-1	xyz	prescribed sea salt bin 1 from GMICHEM
GMICHEMss003	GMICHEM	kg kg-1	xyz	prescribed sea salt bin 3 from GMICHEM
GMICHEMss004	GMICHEM	kg kg-1	xyz	prescribed sea salt bin 4 from GMICHEM
GMICHEMss005	GMICHEM	kg kg-1	xyz	prescribed sea salt bin 5 from GMICHEM
GMICHEMSO4	GMICHEM	kg kg-1	xyz	prescribed sulfate from GMICHEM
REFFICE	GMICHEM	cm	xyz	ice aerosol effective radius
REFFSTS	GMICHEM	cm	xyz	STS aerosol effective radius
VFALL	GMICHEM	cm s-1	xyz	effective aerosol fall velocity
HO2PBLFLAG	GMICHEM	0-1	xyz	PBL flag for HO2 loss in aerosols
EMISOPSFC	GMICHEM	kg m-2 s-1	xy	surface emission of isoprene
EMNOX	GMICHEM	kg m-2 s-1	xy	surface emission of odd nitrogen
EMMONOT	GMICHEM	kg m-2 s-1	xy	surface emission of monoterpenes
EMBIOCOMETH	GMICHEM	kg m-2 s-1	xy	biogenic source of CO from oxidation of methanol
EMBIOCOMONOT	GMICHEM	kg m-2 s-1	xy	biogenic source of CO from oxidation of monoterpenes
EMBIOPROPENE	GMICHEM	kg m-2 s-1	xy	biogenic source of propene
EMSOILNOX	GMICHEM	kg m-2 s-1	xy	soil source of odd nitrogen
EMSHIPHNO3	GMICHEM	kg m-2 s-1	xy	surface ship source of nitric acid
EMSHIPO3	GMICHEM	kg m-2 s-1	xy	surface ship source of ozone
EM_NO	GMICHEM	--->	xyz	nitrous oxide emissions [mol mol-1 s-1]
EM_CO	GMICHEM	--->	xyz	carbon monoxide emissions [mol mol-1 s-1]
EM_MEK	GMICHEM	--->	xyz	methyl ethyl ketone (C4H8O) emissions [mol mol-1 s-1]
EM_PRPE	GMICHEM	--->	xyz	propene (C3H6) emissions [mol mol-1 s-1]
EM_C2H6	GMICHEM	--->	xyz	ethane emissions [mol mol-1 s-1]
EM_C3H8	GMICHEM	--->	xyz	propane emissions [mol mol-1 s-1]
EM_ALK4	GMICHEM	--->	xyz	C45 alkanes (C4H10) emissions [mol mol-1 s-1]
EM_ALD2	GMICHEM	--->	xyz	acetaldehyde (C2H4O) emissions [mol mol-1 s-1]
EM_CH2O	GMICHEM	--->	xyz	formaldehyde emissions [mol mol-1 s-1]
EM_ACET	GMICHEM	--->	xyz	acetone emissions [mol mol-1 s-1]
EM_CH4	GMICHEM	--->	xyz	methane emissions [mol mol-1 s-1]
EM_LGTNO	GMICHEM	--->	xy	NO emissions from lightning [mol mol-1 s-1]
SZAPHOT	GMICHEM	deg	xy	solar zenith angle for GMIchem photolysis
DUSTOD	GMICHEM	1	xyz	dust optical depth (400 nm)
DUSTSA	GMICHEM	cm+2 cm-3	xyz	dust surface area
SO4OD	GMICHEM	1	xyz	sulfate optical depth (400 nm)

Name	Source	Units	Dims	Description
SO4HYGRO	GMICHEM	1	xyz	hygroscopic growth of sulfate
SO4SA	GMICHEM	cm+2 cm-3	xyz	sulfate surface area
BCOD	GMICHEM	1	xyz	black carbon optical depth (400 nm)
BCHYGRO	GMICHEM	1	xyz	hygroscopic growth of black carbon
BCSA	GMICHEM	cm+2 cm-3	xyz	black carbon surface area
OCOD	GMICHEM	1	xyz	organic carbon optical depth (400 nm)
OCHYGRO	GMICHEM	1	xyz	hygroscopic growth of organic carbon
OCSA	GMICHEM	cm+2 cm-3	xyz	organic carbon surface area
SSAOD	GMICHEM	1	xyz	accumulated sea salt optical depth (400 nm)
SSAHYGRO	GMICHEM	1	xyz	hygroscopic growth of accumulated sea salt
SSASA	GMICHEM	cm+2 cm-3	xyz	accumulated sea salt surface area
SSCOD	GMICHEM	1	xyz	coarse sea salt optical depth (400 nm)
SSCHYGRO	GMICHEM	1	xyz	hygroscopic growth of coarse sea salt
SSCSA	GMICHEM	cm+2 cm-3	xyz	coarse sea salt surface area
O3	GMICHEM	kg kg-1	xyz	ozone mass mixing ratio
O3PPMV	GMICHEM	ppmv	xyz	ozone mass mixing ratio in ppm
OX_TEND	GMICHEM	-->	xyz	tendency of odd oxygen mixing ratio due to chemistry [kg kg-1 s-1]
H2O_TEND	GMICHEM	-->	xyz	tendency of water vapor mixing ratio due to chemistry [kg kg-1 s-1]
GMITO3	GMICHEM	dobsons	xy	total ozone
GMITTO3	GMICHEM	dobsons	xy	total tropospheric ozone
GMITROPP	GMICHEM	Pa	xy	tropopause pressure used in GMICHEM
AGCMTROPP	GMICHEM	Pa	xy	tropopause pressure imported into GMICHEM
GMIH2O	GMICHEM	mol mol-1	xyz	gas phase water from GMICHEM
AERO	GMIchem	kg kg-1	xyz	aerosol mass mixing ratios
AERO_DP	GMIchem	kg m-2 s-1	xy	aerosol deposition
HNO3CONDsad	GMIchem	-->	xyz	condensed phase hno3 [mixing_ratio]
HNO3GASsad	GMIchem	-->	xyz	gas phase-hno3 [mixing_ratio]
jNO2val	GMIchem	s^-1	xy	photolysis rate constants for NO
gmiSAD	GMIchem	cm^2cm^3	xyz	surface area densities
gmiQJ	GMIchem	cm3 s-1	xyz	photolysis rate constants
gmiQQJ	GMIchem	cm-3 s-1	xyz	photolysis reaction rates
gmiQK	GMIchem	-->	xyz	thermal rate constants [2-3body_varies]
gmiQQK	GMIchem	cm-3 s-1	xyz	thermal reaction rates
gmiERADIUS	GMIchem	cm	xyz	Aerosol Dust Radii
gmiTAREA	GMIchem	cm^2cm^3	xyz	surface area aerosol dust

3.3 GOCART

Note that the component names on the list refer to the subcomponents of GOCART. In the *HISTORY.rc* file, use GOCART as the component who owns each variable on the list.

Name	Component	Units	Dim	Long Name
BCMASS	BC	kgkg	xyz	Black Carbon Mass Mixing Ratio
BCCONC	BC	kg m-3	xyz	Black Carbon Mass Concentration
BCEXTCOEF	BC	m-1	xyz	Black Carbon Extinction Coefficient [550 nm]
BCSCACOEF	BC	m-1	xyz	Black Carbon Scattering Coefficient [550 nm]
BCEM001	BC	kg m-2 s-1	xy	Black Carbon Emission Bin 001
BCEM002	BC	kg m-2 s-1	xy	Black Carbon Emission Bin 002
BCSD001	BC	kg m-2 s-1	xy	Black Carbon Sedimentation Bin 001
BCSD002	BC	kg m-2 s-1	xy	Black Carbon Sedimentation Bin 002
BCDP001	BC	kg m-2 s-1	xy	Black Carbon Dry Deposition Bin 001
BCDP002	BC	kg m-2 s-1	xy	Black Carbon Dry Deposition Bin 002
BCWT001	BC	kg m-2 s-1	xy	Black Carbon Wet Deposition Bin 001
BCWT002	BC	kg m-2 s-1	xy	Black Carbon Wet Deposition Bin 002
BCSV001	BC	kg m-2 s-1	xy	Black Carbon Convective Scavenging Bin 001
BCSV002	BC	kg m-2 s-1	xy	Black Carbon Convective Scavenging Bin 002
BCHYPHIL	BC	kg m-2 s-1	xy	Black Carbon Hydrophobic to Hydrophilic
BCEMAN	BC	kg m-2 s-1	xy	Black Carbon Anthropogenic Emissions
BCEMBB	BC	kg m-2 s-1	xy	Black Carbon Biomass Burning Emissions
BCEMBF	BC	kg m-2 s-1	xy	Black Carbon Biofuel Emissions
BCSMASS	BC	kg m-3	xy	Black Carbon Surface Mass Concentration
BCCMASS	BC	kg m-2	xy	Black Carbon Column Mass Density
BCEXTTAU	BC	1	xy	Black Carbon Extinction AOT [550 nm]
BCSCATAU	BC	1	xy	Black Carbon Scattering AOT [550 nm]
BCANGSTR	BC	1	xy	Black Carbon Angstrom parameter [470-870 nm]
BCFLUXU	BC	kg m-1 s-1	xy	Black Carbon column u-wind mass flux
BCFLUXV	BC	kg m-1 s-1	xy	Black Carbon column v-wind mass flux
CFC12S	CFC	mol mol-1	xyz	Stratospheric CFC-12 (CCl2F2)
CFC12T	CFC	mol mol-1	xyz	Tropospheric CFC-12 (CCl2F2)
CFC12EM	CFC	kg m-2 s-1	xy	CFC-12 Emission
CFC12SLS	CFC	m-3 s-1	xyz	Stratospheric CFC-12 Loss
CFC12TLS	CFC	m-3 s-1	xyz	Tropospheric CFC-12 Loss
CFC12SCL	CFC	kg m-2	xy	Stratospheric CFC-12 Column

Name	Group	Units	Dim	Description
CFC12TCL	CFC	kg m-2	xy	Tropospheric CFC-12 Column
CFC12PH	CFC	s-1	xyz	CFC-12 Photorate ENSEMBLE
CH4EM	CH4	kg m-2 s-1	xy	CH4 Emission ENSEMBLE
CH4EManimls	CH4	kg m-2 s-1	xy	CH4 Emission animals
CH4EMcoal	CH4	kg m-2 s-1	xy	CH4 Emission coal
CH4EMleak	CH4	kg m-2 s-1	xy	CH4 Emission leakage
CH4EMgasvnt	CH4	kg m-2 s-1	xy	CH4 Emission gas venting
CH4EMhydz	CH4	kg m-2 s-1	xy	CH4 Emission ocean HYDZ
CH4EMmsw	CH4	kg m-2 s-1	xy	CH4 Emission municipal sewers
CH4EMsoilab	CH4	kg m-2 s-1	xy	CH4 Emission soil absorption
CH4EMtrmite	CH4	kg m-2 s-1	xy	CH4 Emission termites
CH4EMbogs	CH4	kg m-2 s-1	xy	CH4 Emission bogs
CH4EMburn	CH4	kg m-2 s-1	xy	CH4 Emission biomass burning
CH4EMricec	CH4	kg m-2 s-1	xy	CH4 Emission rice cultivation
CH4EMswamps	CH4	kg m-2 s-1	xy	CH4 Emission swamps
CH4EMtundra	CH4	kg m-2 s-1	xy	CH4 Emission tundra
CH4EMbf	CH4	kg m-2 s-1	xy	CH4 Emission biofuel
CH4EMtot	CH4	kg m-2 s-1	xy	CH4 Emission total
CH4PD	CH4	kg m-2 s-1	xy	CH4 Chemical Production ENSEMBLE
CH4PDanimls	CH4	kg m-2 s-1	xy	CH4 Chemical Production animals
CH4PDcoal	CH4	kg m-2 s-1	xy	CH4 Chemical Production coal
CH4PDleak	CH4	kg m-2 s-1	xy	CH4 Chemical Production leakage
CH4PDgasvnt	CH4	kg m-2 s-1	xy	CH4 Chemical Production gas venting
CH4PDhydz	CH4	kg m-2 s-1	xy	CH4 Chemical Production ocean HYDZ
CH4PDmsw	CH4	kg m-2 s-1	xy	CH4 Chemical Production municipal sewers
CH4PDsoilab	CH4	kg m-2 s-1	xy	CH4 Chemical Production soil absorption
CH4PDtrmite	CH4	kg m-2 s-1	xy	CH4 Chemical Production termites
CH4PDbogs	CH4	kg m-2 s-1	xy	CH4 Chemical Production bogs
CH4PDburn	CH4	kg m-2 s-1	xy	CH4 Chemical Production biomass burning
CH4PDricec	CH4	kg m-2 s-1	xy	CH4 Chemical Production rice cultivation
CH4PDswamps	CH4	kg m-2 s-1	xy	CH4 Chemical Production swamps
CH4PDtundra	CH4	kg m-2 s-1	xy	CH4 Chemical Production tundra
CH4PDbf	CH4	kg m-2 s-1	xy	CH4 Chemical Production biofuel
CH4PDtot	CH4	kg m-2 s-1	xy	CH4 Chemical Production total
CH4LS	CH4	kg m-2 s-1	xy	CH4 Chemical Loss ENSEMBLE
CH4LSanimls	CH4	kg m-2 s-1	xy	CH4 Chemical Loss animals
CH4LScoal	CH4	kg m-2 s-1	xy	CH4 Chemical Loss coal
CH4LSleak	CH4	kg m-2 s-1	xy	CH4 Chemical Loss leakage
CH4LSgasvnt	CH4	kg m-2 s-1	xy	CH4 Chemical Loss gas venting

CH4LShydz	CH4	kg m-2 s-1	xy	CH4 Chemical Loss ocean HYDZ
CH4LSmsw	CH4	kg m-2 s-1	xy	CH4 Chemical Loss municipal sewers
CH4LSsoilab	CH4	kg m-2 s-1	xy	CH4 Chemical Loss soil absorption
CH4LStrmite	CH4	kg m-2 s-1	xy	CH4 Chemical Loss termites
CH4LSbogs	CH4	kg m-2 s-1	xy	CH4 Chemical Loss bogs
CH4LSburn	CH4	kg m-2 s-1	xy	CH4 Chemical Loss biomass burning
CH4LSricec	CH4	kg m-2 s-1	xy	CH4 Chemical Loss rice cultivation
CH4LSswamps	CH4	kg m-2 s-1	xy	CH4 Chemical Loss swamps
CH4LStundra	CH4	kg m-2 s-1	xy	CH4 Chemical Loss tundra
CH4LSbf	CH4	kg m-2 s-1	xy	CH4 Chemical Loss biofuel
CH4LStot	CH4	kg m-2 s-1	xy	CH4 Chemical Loss total
CH4SC	CH4	ppbv	xy	CH4 Surface Concentration ENSEMBLE
CH4SCanimls	CH4	ppbv	xy	CH4 Surface Concentration animals
CH4SCcoal	CH4	ppbv	xy	CH4 Surface Concentration coal
CH4SCleak	CH4	ppbv	xy	CH4 Surface Concentration leakage
CH4SCgasvnt	CH4	ppbv	xy	CH4 Surface Concentration gas venting
CH4SChydz	CH4	ppbv	xy	CH4 Surface Concentration ocean HYDZ
CH4SCmsw	CH4	ppbv	xy	CH4 Surface Concentration municipal sewers
CH4SCsoilab	CH4	ppbv	xy	CH4 Surface Concentration soil absorption
CH4SCtrmite	CH4	ppbv	xy	CH4 Surface Concentration termites
CH4SCbogs	CH4	ppbv	xy	CH4 Surface Concentration bogs
CH4SCburn	CH4	ppbv	xy	CH4 Surface Concentration biomass burning
CH4SCricec	CH4	ppbv	xy	CH4 Surface Concentration rice cultivation
CH4SCswamps	CH4	ppbv	xy	CH4 Surface Concentration swamps
CH4SCtundra	CH4	ppbv	xy	CH4 Surface Concentration tundra
CH4SCbf	CH4	ppbv	xy	CH4 Surface Concentration biofuel
CH4SCtot	CH4	ppbv	xy	CH4 Surface Concentration total
CH4CL	CH4	kg m-2	xy	CH4 Column Burden ENSEMBLE
CH4CLanimls	CH4	kg m-2	xy	CH4 Column Burden animals
CH4CLcoal	CH4	kg m-2	xy	CH4 Column Burden coal
CH4CLleak	CH4	kg m-2	xy	CH4 Column Burden leakage
CH4CLgasvnt	CH4	kg m-2	xy	CH4 Column Burden gas venting
CH4CLhydz	CH4	kg m-2	xy	CH4 Column Burden ocean HYDZ
CH4CLmsw	CH4	kg m-2	xy	CH4 Column Burden municipal sewers
CH4CLsoilab	CH4	kg m-2	xy	CH4 Column Burden soil absorption
CH4CLtrmite	CH4	kg m-2	xy	CH4 Column Burden termites
CH4CLbogs	CH4	kg m-2	xy	CH4 Column Burden bogs
CH4CLburn	CH4	kg m-2	xy	CH4 Column Burden biomass burning
CH4CLricec	CH4	kg m-2	xy	CH4 Column Burden rice cultivation

CH4CLswamps	CH4	kg m-2	xy	CH4 Column Burden swamps
CH4CLtundra	CH4	kg m-2	xy	CH4 Column Burden tundra
CH4CLbf	CH4	kg m-2	xy	CH4 Column Burden biofuel
CH4CLtot	CH4	kg m-2	xy	CH4 Column Burden total
CH4JL	CH4	m-3 s-1	xyz	CH4 Photolytic Loss ENSEMBLE
CH4JLanimls	CH4	m-3 s-1	xyz	CH4 Photolytic Loss animals
CH4JLcoal	CH4	m-3 s-1	xyz	CH4 Photolytic Loss coal
CH4JLleak	CH4	m-3 s-1	xyz	CH4 Photolytic Loss leakage
CH4JLgasvnt	CH4	m-3 s-1	xyz	CH4 Photolytic Loss gas venting
CH4JLhydz	CH4	m-3 s-1	xyz	CH4 Photolytic Loss ocean HYDZ
CH4JLmsw	CH4	m-3 s-1	xyz	CH4 Photolytic Loss municipal sewers
CH4JLsoilab	CH4	m-3 s-1	xyz	CH4 Photolytic Loss soil absorption
CH4JLtrmite	CH4	m-3 s-1	xyz	CH4 Photolytic Loss termites
CH4JLbogs	CH4	m-3 s-1	xyz	CH4 Photolytic Loss bogs
CH4JLburn	CH4	m-3 s-1	xyz	CH4 Photolytic Loss biomass burning
CH4JLricec	CH4	m-3 s-1	xyz	CH4 Photolytic Loss rice cultivation
CH4JLswamps	CH4	m-3 s-1	xyz	CH4 Photolytic Loss swamps
CH4JLtundra	CH4	m-3 s-1	xyz	CH4 Photolytic Loss tundra
CH4JLbf	CH4	m-3 s-1	xyz	CH4 Photolytic Loss biofuel
CH4JLtot	CH4	m-3 s-1	xyz	CH4 Photolytic Loss total
CH4QP	CH4	--->	xyz	H2O tendency from CH4 photolysis ENSEMBLE [kg kg-1 s-1]
CH4QPanimls	CH4	--->	xyz	H2O tendency from CH4 photolysis animals [kg kg-1 s-1]
CH4QPcoal	CH4	--->	xyz	H2O tendency from CH4 photolysis coal [kg kg-1 s-1]
CH4QPleak	CH4	--->	xyz	H2O tendency from CH4 photolysis leakage [kg kg-1 s-1]
CH4QPgasvnt	CH4	--->	xyz	H2O tendency from CH4 photolysis gas venting [kg kg-1 s-1]
CH4QPhydz	CH4	--->	xyz	H2O tendency from CH4 photolysis ocean HYDZ [kg kg-1 s-1]
CH4QPmsw	CH4	--->	xyz	H2O tendency from CH4 photolysis municipal sewers [kg kg-1 s-1]
CH4QPsoilab	CH4	--->	xyz	H2O tendency from CH4 photolysis soil absorption [kg kg-1 s-1]
CH4QPtrmite	CH4	--->	xyz	H2O tendency from CH4 photolysis termites [kg kg-1 s-1]
CH4QPbogs	CH4	--->	xyz	H2O tendency from CH4 photolysis bogs [kg kg-1 s-1]
CH4QPburn	CH4	--->	xyz	H2O tendency from CH4 photolysis biomass burning [kg kg-1 s-1]
CH4QPricec	CH4	--->	xyz	H2O tendency from CH4 photolysis rice cultivation [kg kg-1 s-1]
CH4QPswamps	CH4	--->	xyz	H2O tendency from CH4 photolysis swamps [kg kg-1 s-1]
CH4QPtundra	CH4	--->	xyz	H2O tendency from CH4 photolysis tundra [kg kg-1 s-1]
CH4QPbf	CH4	--->	xyz	H2O tendency from CH4 photolysis biofuel [kg kg-1 s-1]
CH4QPtot	CH4	--->	xyz	H2O tendency from CH4 photolysis total [kg kg-1 s-1]
CH4DRY	CH4	mol mol-1	xyz	CH4 dry air mole fraction ENSEMBLE
CH4DRYanimls	CH4	mol mol-1	xyz	CH4 dry air mole fraction animals
CH4DRYcoal	CH4	mol mol-1	xyz	CH4 dry air mole fraction coal

Variable	Species	Description	Units	Dims
CH4DRYleak	CH4	CH4 dry air mole fraction leakage	mol mol-1	xyz
CH4DRYgasvnt	CH4	CH4 dry air mole fraction gas venting	mol mol-1	xyz
CH4DRYhydz	CH4	CH4 dry air mole fraction ocean HYDZ	mol mol-1	xyz
CH4DRYmsw	CH4	CH4 dry air mole fraction municipal sewers	mol mol-1	xyz
CH4DRYsoilab	CH4	CH4 dry air mole fraction soil absorption	mol mol-1	xyz
CH4DRYtrmite	CH4	CH4 dry air mole fraction termites	mol mol-1	xyz
CH4DRYbogs	CH4	CH4 dry air mole fraction bogs	mol mol-1	xyz
CH4DRYburn	CH4	CH4 dry air mole fraction biomass burning	mol mol-1	xyz
CH4DRYricec	CH4	CH4 dry air mole fraction rice cultivation	mol mol-1	xyz
CH4DRYswamps	CH4	CH4 dry air mole fraction swamps	mol mol-1	xyz
CH4DRYtundra	CH4	CH4 dry air mole fraction tundra	mol mol-1	xyz
CH4DRYbf	CH4	CH4 dry air mole fraction biofuel	mol mol-1	xyz
CH4DRYtot	CH4	CH4 dry air mole fraction total	mol mol-1	xyz
COEM	CO	CO Emission ENSEMBLE	kg m-2 s-1	xy
COEMbbo	CO	CO Emission (Boreal Biomass Burning)	kg m-2 s-1	xy
COEMbbnb	CO	CO Emission (Non-Boreal Biomass Burning)	kg m-2 s-1	xy
COEMffru	CO	CO Emission (Anthopogenic Emissions Northern Asia)	kg m-2 s-1	xy
COEMffas	CO	CO Emission (Anthopogenic Emissions Southern Asia)	kg m-2 s-1	xy
COEMffeu	CO	CO Emission (Anthopogenic Emissions Europe)	kg m-2 s-1	xy
COEMffna	CO	CO Emission (Anthopogenic Emissions North America)	kg m-2 s-1	xy
COEMbbae	CO	CO Emission (Asia and Europe Biomass Burning)	kg m-2 s-1	xy
COEMbbna	CO	CO Emission (North America Biomass Burning)	kg m-2 s-1	xy
COEMbbla	CO	CO Emission (Central and South America Biomass Burning)	kg m-2 s-1	xy
COEMbbaf	CO	CO Emission (Africa Biomass Burning)	kg m-2 s-1	xy
COEMbgl	CO	CO Emission (Global Biomass Burning)	kg m-2 s-1	xy
COEMbas	CO	CO Emission (Asia Non-Biomass Burning)	kg m-2 s-1	xy
COEMbeu	CO	CO Emission (European Non-Biomass Burning)	kg m-2 s-1	xy
COEMnbna	CO	CO Emission (North American Non-Biomass Burning)	kg m-2 s-1	xy
COEMnbgl	CO	CO Emission (Global Non-Biomass Burning)	kg m-2 s-1	xy
COPD	CO	CO Chemical Production ENSEMBLE	kg m-2 s-1	xy
COPDbbo	CO	CO Chemical Production (Boreal Biomass Burning)	kg m-2 s-1	xy
COPDbbnb	CO	CO Chemical Production (Non-Boreal Biomass Burning)	kg m-2 s-1	xy
COPDffru	CO	CO Chemical Production (Anthopogenic Emissions Northern Asia)	kg m-2 s-1	xy
COPDffas	CO	CO Chemical Production (Anthopogenic Emissions Southern Asia)	kg m-2 s-1	xy
COPDffeu	CO	CO Chemical Production (Anthopogenic Emissions Europe)	kg m-2 s-1	xy
COPDffna	CO	CO Chemical Production (Anthopogenic Emissions North America)	kg m-2 s-1	xy
COPDbbae	CO	CO Chemical Production (Asia and Europe Biomass Burning)	kg m-2 s-1	xy
COPDbbna	CO	CO Chemical Production (North America Biomass Burning)	kg m-2 s-1	xy
COPDbbla	CO	CO Chemical Production (Central and South America Biomass Burning)	kg m-2 s-1	xy

Variable		Units	Grid	Description
COPDbbaf	CO	kg m-2 s-1	xy	CO Chemical Production (Africa Biomass Burning)
COPDbbgl	CO	kg m-2 s-1	xy	CO Chemical Production (Global Biomass Burning)
COPDnbas	CO	kg m-2 s-1	xy	CO Chemical Production (Asia Non-Biomass Burning)
COPDnbeu	CO	kg m-2 s-1	xy	CO Chemical Production (European Non-Biomass Burning)
COPDnbna	CO	kg m-2 s-1	xy	CO Chemical Production (North American Non-Biomass Burning)
COPDnbgl	CO	kg m-2 s-1	xy	CO Chemical Production (Global Non-Biomass Burning)
COLS	CO	kg m-2 s-1	xy	CO Chemical Loss ENSEMBLE
COLSbbo	CO	km m-2 s-1	xy	CO Chemical Loss (Boreal Biomass Burning)
COLSbbnb	CO	km m-2 s-1	xy	CO Chemical Loss (Non-Boreal Biomass Burning)
COLSffru	CO	km m-2 s-1	xy	CO Chemical Loss (Anthopogenic Emissions Northern Asia)
COLSffas	CO	km m-2 s-1	xy	CO Chemical Loss (Anthopogenic Emissions Southern Asia)
COLSffeu	CO	km m-2 s-1	xy	CO Chemical Loss (Anthopogenic Emissions Europe)
COLSffna	CO	km m-2 s-1	xy	CO Chemical Loss (Anthopogenic Emissions North America)
COLSbbae	CO	km m-2 s-1	xy	CO Chemical Loss (Asia and Europe Biomass Burning)
COLSbbna	CO	km m-2 s-1	xy	CO Chemical Loss (North America Biomass Burning)
COLSbbla	CO	km m-2 s-1	xy	CO Chemical Loss (Central and South America Biomass Burning)
COLSbbaf	CO	km m-2 s-1	xy	CO Chemical Loss (Africa Biomass Burning)
COLSbbgl	CO	km m-2 s-1	xy	CO Chemical Loss (Global Biomass Burning)
COLSnbas	CO	kg m-2 s-1	xy	CO Chemical Loss (Asia Non-Biomass Burning)
COLSnbeu	CO	kg m-2 s-1	xy	CO Chemical Loss (European Non-Biomass Burning)
COLSnbna	CO	kg m-2 s-1	xy	CO Chemical Loss (North American Non-Biomass Burning)
COLSnbgl	CO	kg m-2 s-1	xy	CO Chemical Loss (Global Non-Biomass Burning)
COSC	CO	1e-9	xy	CO Surface Concentration in ppbv ENSEMBLE
COSCbbo	CO	1e-9	xy	CO Surface Concentration in ppbv (Boreal Biomass Burning)
COSCbbnb	CO	1e-9	xy	CO Surface Concentration in ppbv (Non-Boreal Biomass Burning)
COSCffru	CO	1e-9	xy	CO Surface Concentration in ppbv (Anthopogenic Emissions Northern Asia)
COSCffas	CO	1e-9	xy	CO Surface Concentration in ppbv (Anthopogenic Emissions Southern Asia)
COSCffeu	CO	1e-9	xy	CO Surface Concentration in ppbv (Anthopogenic Emissions Europe)
COSCffna	CO	1e-9	xy	CO Surface Concentration in ppbv (Anthopogenic Emissions North America)
COSCbbae	CO	1e-9	xy	CO Surface Concentration in ppbv (Asia and Europe Biomass Burning)
COSCbbna	CO	1e-9	xy	CO Surface Concentration in ppbv (North America Biomass Burning)
COSCbbla	CO	1e-9	xy	CO Surface Concentration in ppbv (Central and South America Biomass Burning)
COSCbbaf	CO	1e-9	xy	CO Surface Concentration in ppbv (Africa Biomass Burning)
COSCbbgl	CO	1e-9	xy	CO Surface Concentration in ppbv (Global Biomass Burning)
COSCnbas	CO	1e-9	xy	CO Surface Concentration in ppbv (Asia Non-Biomass Burning)
COSCnbeu	CO	1e-9	xy	CO Surface Concentration in ppbv (European Non-Biomass Burning)
COSCnbna	CO	1e-9	xy	CO Surface Concentration in ppbv (North American Non-Biomass Burning)
COSCnbgl	CO	1e-9	xy	CO Surface Concentration in ppbv (Global Non-Biomass Burning)
COCL	CO	kg m-2	xy	CO Column Burden ENSEMBLE

Name	Units	Dims	Description
COCLbbbo	kg m-2	xy	CO Column Burden (Boreal Biomass Burning)
COCLbbnb	kg m-2	xy	CO Column Burden (Non-Boreal Biomass Burning)
COCLffru	kg m-2	xy	CO Column Burden (Anthopogenic Emissions Northern Asia)
COCLffas	kg m-2	xy	CO Column Burden (Anthopogenic Emissions Southern Asia)
COCLffeu	kg m-2	xy	CO Column Burden (Anthopogenic Emissions Europe)
COCLffna	kg m-2	xy	CO Column Burden (Anthopogenic Emissions North America)
COCLbbae	kg m-2	xy	CO Column Burden (Asia and Europe Biomass Burning)
COCLbbna	kg m-2	xy	CO Column Burden (North America Biomass Burning)
COCLbbla	kg m-2	xy	CO Column Burden (Central and South America Biomass Burning)
COCLbbaf	kg m-2	xy	CO Column Burden (Africa Biomass Burning)
COCLbbgl	kg m-2	xy	CO Column Burden (Global Biomass Burning)
COCLnbas	kg m-2	xy	CO Column Burden (Asia Non-Biomass Burning)
COCLnbeu	kg m-2	xy	CO Column Burden (European Non-Biomass Burning)
COCLnbna	kg m-2	xy	CO Column Burden (North American Non-Biomass Burning)
COCLnbgl	kg m-2	xy	CO Column Burden (Global Non-Biomass Burning)
CO2	molmol	xyz	Carbon Dioxide
CO2NAMER	molmol	xyz	North American Carbon Dioxide
CO2SAMER	molmol	xyz	South American Carbon Dioxide
CO2AFRIC	molmol	xyz	African Carbon Dioxide
CO2EM001	kg m-2 s-1	xy	CO2 Emission Bin 001
CO2EM002	kg m-2 s-1	xy	CO2 Emission Bin 002
CO2EM003	kg m-2 s-1	xy	CO2 Emission Bin 003
CO2EM004	kg m-2 s-1	xy	CO2 Emission Bin 004
CO2CL001	1	xy	CO2 Bulk Mixing Ratio (Column Massps) Bin 001
CO2CL002	1	xy	CO2 Bulk Mixing Ratio (Column Massps) Bin 002
CO2CL003	1	xy	CO2 Bulk Mixing Ratio (Column Massps) Bin 003
CO2CL004	1	xy	CO2 Bulk Mixing Ratio (Column Massps) Bin 004
CO2SC001	1e-6	xy	CO2 Surface Concentration Bin 001
CO2SC002	1e-6	xy	CO2 Surface Concentration Bin 002
CO2SC003	1e-6	xy	CO2 Surface Concentration Bin 003
CO2SC004	1e-6	xy	CO2 Surface Concentration Bin 004
DUMASS	kg kg-1	xyz	Dust Mass Mixing Ratio
DUMASS25	kg kg-1	xyz	Dust Mass Mixing Ratio - PM 2.5
DUCONC	kg m-3	xyz	Dust Mass Concentration
DUEXTCOEF	m-1	xyz	Dust Extinction Coefficient [550 nm]
DUSCACOEF	m-1	xyz	Dust Scattering Coefficient [550 nm]
DUEM001	kg m-2 s-1	xy	Dust Emission Bin 001
DUEM002	kg m-2 s-1	xy	Dust Emission Bin 002
DUEM003	kg m-2 s-1	xy	Dust Emission Bin 003

DUEMO04	DU	kg m-2 s-1	xy	Dust Emission Bin 004
DUEMO05	DU	kg m-2 s-1	xy	Dust Emission Bin 005
DUSD001	DU	kg m-2 s-1	xy	Dust Sedimentation Bin 001
DUSD002	DU	kg m-2 s-1	xy	Dust Sedimentation Bin 002
DUSD003	DU	kg m-2 s-1	xy	Dust Sedimentation Bin 003
DUSD004	DU	kg m-2 s-1	xy	Dust Sedimentation Bin 004
DUSD005	DU	kg m-2 s-1	xy	Dust Sedimentation Bin 005
DUDP001	DU	kg m-2 s-1	xy	Dust Dry Deposition Bin 001
DUDP002	DU	kg m-2 s-1	xy	Dust Dry Deposition Bin 002
DUDP003	DU	kg m-2 s-1	xy	Dust Dry Deposition Bin 003
DUDP004	DU	kg m-2 s-1	xy	Dust Dry Deposition Bin 004
DUDP005	DU	kg m-2 s-1	xy	Dust Dry Deposition Bin 005
DUWT001	DU	kg m-2 s-1	xy	Dust Wet Deposition Bin 001
DUWT002	DU	kg m-2 s-1	xy	Dust Wet Deposition Bin 002
DUWT003	DU	kg m-2 s-1	xy	Dust Wet Deposition Bin 003
DUWT004	DU	kg m-2 s-1	xy	Dust Wet Deposition Bin 004
DUWT005	DU	kg m-2 s-1	xy	Dust Wet Deposition Bin 005
DUSV001	DU	kg m-2 s-1	xy	Dust Convective Scavenging Bin 001
DUSV002	DU	kg m-2 s-1	xy	Dust Convective Scavenging Bin 002
DUSV003	DU	kg m-2 s-1	xy	Dust Convective Scavenging Bin 003
DUSV004	DU	kg m-2 s-1	xy	Dust Convective Scavenging Bin 004
DUSV005	DU	kg m-2 s-1	xy	Dust Convective Scavenging Bin 005
DUSMASS	DU	kg m-3	xy	Dust Surface Mass Concentration
DUCMASS	DU	kg m-2	xy	Dust Column Mass Density
DUEXTTAU	DU	1	xy	Dust Extinction AOT [550 nm]
DUSCATAU	DU	1	xy	Dust Scattering AOT [550 nm]
DUSMASS25	DU	kg m-3	xy	Dust Surface Mass Concentration - PM 2.5
DUCMASS25	DU	kg m-2	xy	Dust Column Mass Density - PM 2.5
DUEXTT25	DU	1	xy	Dust Extinction AOT [550 nm] - PM 2.5
DUSCAT25	DU	1	xy	Dust Scattering AOT [550 nm] - PM 2.5
DUAERIDX	DU	1	xy	Dust TOMS UV Aerosol Index
DUFLUXU	DU	kg m-1 s-1	xy	Dust column u-wind mass flux
DUFLUXV	DU	kg m-1 s-1	xy	Dust column v-wind mass flux
DUEXTTFM	DU	1	xy	Dust Extinction AOT [550 nm] - PM 1.0 um
DUSCATFM	DU	1	xy	Dust Scattering AOT [550 nm] - PM 1.0 um
DUANGSTR	DU	1	xy	Dust Angstrom parameter [470-870 nm]
AERO	GOCART	kg kg-1	xyz	aerosol mass mixing ratios
AERO_DP	GOCART	kg m-2 s-1	xy	aerosol deposition
TOTEXTTAU	GOCART	1	xy	Total Aerosol Extinction AOT [550 nm]

Name	Group	Units	Dim	Description	
TOTSCATAU	GOCART	1	xy	Total Aerosol Scattering AOT [550 nm]	
TOTEXTT25	GOCART	1	xy	Total Aerosol Extinction AOT [550 nm] - PM2.5	
TOTSCAT25	GOCART	1	xy	Total Aerosol Scattering AOT [550 nm] - PM2.5	
TOTEXTTFM	GOCART	1	xy	Total Aerosol Exinction AOT [550 nm] - PM1.0	
TOTSCATFM	GOCART	1	xy	Total Aerosol Scattering AOT [550 nm] - PM1.0	
TOTANGSTR	GOCART	1	xy	Total Aerosol Angstrom parameter [470-870 nm]	
O3	O3	kg kg-1	xyz	Ozone mass mixing ratio	
OX	O3	mol mol-1	xyz	Ozone volume mixing ratio	
O3DDV	O3	m s-1	xy	Dry deposition speed	
O3PPMV	O3	ppmv	xyz	Ozone	
O3TOT	O3	Dobsons	xy	Total ozone	
O3DDP	O3	kg m-2 s-1	xy	Ozone dry deposition	
DO3DT	O3	-->	xyz	Ozone tendency [kg kg-1 s-1]	
OX_TEND	O3	-->	xyz	tendency of odd oxygen mixing ratio due to chemistry [mol mol-1 s-1]	
OCMASS	OC	kg kg-1	xyz	Organic Carbon Mass Mixing Ratio	ENSEMBLE
OCCONC	OC	kg m-3	xyz	Organic Carbon Mass Concentration	ENSEMBLE
OCEXTCOEF	OC	m-1	xyz	Organic Carbon Ext. Coefficient [550 nm]	ENSEMBLE
OCSCACOEF	OC	m-1	xyz	Organic Carbon Scatt. Coefficient [550 nm]	ENSEMBLE
OCEM001	OC	kg m-2 s-1	xy	Organic Carbon Emission Bin 001	ENSEMBLE
OCEM002	OC	kg m-2 s-1	xy	Organic Carbon Emission Bin 002	ENSEMBLE
OCSD001	OC	kg m-2 s-1	xy	Organic Carbon Sedimentation Bin 001	ENSEMBLE
OCSD002	OC	kg m-2 s-1	xy	Organic Carbon Sedimentation Bin 002	ENSEMBLE
OCDP001	OC	kg m-2 s-1	xy	Organic Carbon Dry Deposition Bin 001	ENSEMBLE
OCDP002	OC	kg m-2 s-1	xy	Organic Carbon Dry Deposition Bin 002	ENSEMBLE
OCWT001	OC	kg m-2 s-1	xy	Organic Carbon Wet Deposition Bin 001	ENSEMBLE
OCWT002	OC	kg m-2 s-1	xy	Organic Carbon Wet Deposition Bin 002	ENSEMBLE
OCSV001	OC	kg m-2 s-1	xy	Organic Carbon Convective Scavenging Bin 001	ENSEMBLE
OCSV002	OC	kg m-2 s-1	xy	Organic Carbon Convective Scavenging Bin 002	ENSEMBLE
OCHYPHIL	OC	kg m-2 s-1	xy	Organic Carbon Hydrophobic to Hydrophilic	ENSEMBLE
OCEMAN	OC	kg m-2 s-1	xy	Organic Carbon Anthropogenic Emissions	ENSEMBLE
OCEMBB	OC	kg m-2 s-1	xy	Organic Carbon Biomass Burning Emissions	ENSEMBLE
OCEMBF	OC	kg m-2 s-1	xy	Organic Carbon Biofuel Emissions	ENSEMBLE
OCEMBG	OC	kg m-2 s-1	xy	Organic Carbon Biogenic Emissions	ENSEMBLE
OCSMASS	OC	kg m-3	xy	Organic Carbon Surface Mass Concentration	ENSEMBLE
OCCMASS	OC	kg m-2	xy	Organic Carbon Column Mass Density	ENSEMBLE
OCEXTTAU	OC	1	xy	Organic Carbon Extinction AOT [550 nm]	ENSEMBLE
OCSCATAU	OC	1	xy	Organic Carbon Scattering AOT [550 nm]	ENSEMBLE
OCANGSTR	OC	1	xy	Organic Carbon Angstrom parameter [470-870 nm]	ENSEMBLE
OCFLUXU	OC	kg m-1 s-1	xy	Organic Carbon column u-wind mass flux	ENSEMBLE

Name	Type	Units	Dim	Description
OCFLUXV	OC	kg m-1 s-1	xy	Organic Carbon column v-wind mass flux
RnEM	Rn	kg m-2 s-1	xy	Rn Emission ENSEMBLE
RnEMAsia	Rn	kg m-2 s-1	xy	Rn Emission Asia
RnEMEuro	Rn	kg m-2 s-1	xy	Rn Emission Europe
RnEMNoAm	Rn	kg m-2 s-1	xy	Rn Emission North America
RnEMSoAm	Rn	kg m-2 s-1	xy	Rn Emission South America
RnEMAfri	Rn	kg m-2 s-1	xy	Rn Emission Africa
RnEMAust	Rn	kg m-2 s-1	xy	Rn Emission Australia
RnLS	Rn	kg m-2 s-1	xy	Rn Decay ENSEMBLE
RnLSAsia	Rn	kg m-2 s-1	xy	Rn Decay Asia
RnLSEuro	Rn	kg m-2 s-1	xy	Rn Decay Europe
RnLSNoAm	Rn	kg m-2 s-1	xy	Rn Decay North America
RnLSSoAm	Rn	kg m-2 s-1	xy	Rn Decay South America
RnLSAfri	Rn	kg m-2 s-1	xy	Rn Decay Africa
RnLSAust	Rn	kg m-2 s-1	xy	Rn Decay Australia
RnSC	Rn	molmol	xy	Rn Surface Concentration ENSEMBLE
RnSCAsia	Rn	molmol	xy	Rn Surface Concentration Asia
RnSCEuro	Rn	molmol	xy	Rn Surface Concentration Europe
RnSCNoAm	Rn	molmol	xy	Rn Surface Concentration North America
RnSCSoAm	Rn	molmol	xy	Rn Surface Concentration South America
RnSCAfri	Rn	molmol	xy	Rn Surface Concentration Africa
RnSCAust	Rn	molmol	xy	Rn Surface Concentration Australia
RnCL	Rn	kg m-2	xy	Rn Column Burden ENSEMBLE
RnCLAsia	Rn	kg m-2	xy	Rn Column Burden Asia
RnCLEuro	Rn	kg m-2	xy	Rn Column Burden Europe
RnCLNoAm	Rn	kg m-2	xy	Rn Column Burden North America
RnCLSoAm	Rn	kg m-2	xy	Rn Column Burden South America
RnCLAfri	Rn	kg m-2	xy	Rn Column Burden Africa
RnCLAust	Rn	kg m-2	xy	Rn Column Burden Australia
SSMASS	SS	kg kg-1	xyz	Sea Salt Mass Mixing Ratio
SSMASS25	SS	kg kg-1	xyz	Sea Salt Mass Mixing Ratio - PM 2.5
SSCONC	SS	kg m-3	xyz	Sea Salt Mass Concentration
SSEXTCOEF	SS	m-1	xyz	Sea Salt Extinction Coefficient [550 nm]
SSSCACOEF	SS	m-1	xyz	Sea Salt Scattering Coefficient [550 nm]
SSEM001	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 001
SSEM002	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 002
SSEM003	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 003
SSEM004	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 004
SSEM005	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 005

SSSD001	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 001
SSSD002	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 002
SSSD003	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 003
SSSD004	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 004
SSSD005	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 005
SSDP001	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 001
SSDP002	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 002
SSDP003	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 003
SSDP004	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 004
SSDP005	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 005
SSWT001	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 001
SSWT002	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 002
SSWT003	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 003
SSWT004	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 004
SSWT005	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 005
SSSV001	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 001
SSSV002	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 002
SSSV003	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 003
SSSV004	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 004
SSSV005	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 005
SSSMASS	SS	kg m-3	xy	Sea Salt Surface Mass Concentration
SSCMASS	SS	kg m-2	xy	Sea Salt Column Mass Density
SSEXTTAU	SS	1	xy	Sea Salt Extinction AOT [550 nm]
SSSCATAU	SS	1	xy	Sea Salt Scattering AOT [550 nm]
SSSMASS25	SS	kg m-3	xy	Sea Salt Surface Mass Concentration - PM 2.5
SSCMASS25	SS	kg m-2	xy	Sea Salt Column Mass Density - PM 2.5
SSEXTT25	SS	1	xy	Sea Salt Extinction AOT [550 nm] - PM 2.5
SSSCAT25	SS	1	xy	Sea Salt Scattering AOT [550 nm] - PM 2.5
SSAERIDX	SS	1	xy	Sea Salt TOMS UV Aerosol Index
SSEXTTFM	SS	1	xy	Sea Salt Extinction AOT [550 nm] - PM 1.0 um
SSSCATFM	SS	1	xy	Sea Salt Scattering AOT [550 nm] - PM 1.0 um
SSANGSTR	SS	1	xy	Sea Salt Angstrom parameter [470-870 nm]
SSFLUXU	SS	kg m-1 s-1	xy	Sea Salt column u-wind mass flux
SSFLUXV	SS	kg m-1 s-1	xy	Sea Salt column v-wind mass flux
SUEM001	SU	kg m-2 s-1	xy	Sulfate Emission Bin 001 ENSEMBLE
SUEM002	SU	kg m-2 s-1	xy	Sulfate Emission Bin 002 ENSEMBLE
SUEM003	SU	kg m-2 s-1	xy	Sulfate Emission Bin 003 ENSEMBLE
SUEM004	SU	kg m-2 s-1	xy	Sulfate Emission Bin 004 ENSEMBLE
SUDP001	SU	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 001 ENSEMBLE

Name	Group	Units	Dims	Description	
SUDP002	SU	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 002	ENSEMBLE
SUDP003	SU	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 003	ENSEMBLE
SUDP004	SU	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 004	ENSEMBLE
SUSD001	SU	kg m-2 s-1	xy	Sulfate Settling Bin 001	ENSEMBLE
SUSD002	SU	kg m-2 s-1	xy	Sulfate Settling Bin 002	ENSEMBLE
SUSD003	SU	kg m-2 s-1	xy	Sulfate Settling Bin 003	ENSEMBLE
SUSD004	SU	kg m-2 s-1	xy	Sulfate Settling Bin 004	ENSEMBLE
SUWT001	SU	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 001	ENSEMBLE
SUWT002	SU	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 002	ENSEMBLE
SUWT003	SU	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 003	ENSEMBLE
SUWT004	SU	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 004	ENSEMBLE
SUSV001	SU	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 001	ENSEMBLE
SUSV002	SU	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 002	ENSEMBLE
SUSV003	SU	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 003	ENSEMBLE
SUSV004	SU	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 004	ENSEMBLE
SO4EMAN	SU	kg m-2 s-1	xy	SO4 Anthropogenic Emissions	ENSEMBLE
SO2EMAN	SU	kg m-2 s-1	xy	SO2 Anthropogenic Emissions	ENSEMBLE
SO2EMBB	SU	kg m-2 s-1	xy	SO2 Biomass Burning Emissions	ENSEMBLE
SO2EMVN	SU	kg m-2 s-1	xy	SO2 Volcanic (non-explosive) Emissions	ENSEMBLE
SO2EMVE	SU	kg m-2 s-1	xy	SO2 Volcanic (explosive) Emissions	ENSEMBLE
PSO2	SU	kg m-2 s-1	xyz	SO2 Prod from DMS oxidation	ENSEMBLE
PMSA	SU	kg m-2 s-1	xyz	MSA Prod from DMS oxidation	ENSEMBLE
PSO4G	SU	kg m-2 s-1	xyz	SO4 Prod from SO2 oxidation	ENSEMBLE
PSO4WET	SU	kg m-2 s-1	xyz	SO4 Prod from wet SO2 oxidation	ENSEMBLE
PSO4AQ	SU	kg m-2 s-1	xyz	SO4 Prod from aqueous SO2 oxidation	ENSEMBLE
SUPSO2	SU	kg m-2 s-1	xy	SO2 Prod from DMS Oxidation [column]	ENSEMBLE
SUPSO4G	SU	kg m-2 s-1	xy	SO4 Prod from Gaseous SO2 Oxidation [column]	ENSEMBLE
SUPSO4AQ	SU	kg m-2 s-1	xy	SO4 Prod from Aqueous SO2 Oxidation [column]	ENSEMBLE
SUPSO4WT	SU	kg m-2 s-1	xy	SO4 Prod from Aqueous SO2 Oxidation (wet dep) [column]	ENSEMBLE
SUPMSA	SU	kg m-2 s-1	xy	MSA Prod from DMS Oxidation [column]	ENSEMBLE
SO2SMASS	SU	kg m-3	xy	SO2 Surface Mass Concentration	ENSEMBLE
SO2CMASS	SU	kg m-2	xy	SO2 Column Mass Density	ENSEMBLE
SO4SMASS	SU	kg m-3	xy	SO4 Surface Mass Concentration	ENSEMBLE
SO4CMASS	SU	kg m-2	xy	SO4 Column Mass Density	ENSEMBLE
DMSSMASS	SU	kg m-3	xy	DMS Surface Mass Concentration	ENSEMBLE
DMSCMASS	SU	kg m-2	xy	DMS Column Mass Density	ENSEMBLE
SUCONC	SU	kg m-3	xyz	SO4 Aerosol Mass Concentration	ENSEMBLE
SUEXTCOEF	SU	m-1	xyz	SO4 Extinction Coefficient [550 nm]	ENSEMBLE
SUSCACOEF	SU	m-1	xyz	SO4 Scattering Coefficient [550 nm]	ENSEMBLE

Name	Units	Dims	Description
SUANGSTR	1	xy	SO4 Angstrom parameter [470-870 nm] ENSEMBLE
SUFLUXU	kg m-1 s-1	xy	SO4 column u-wind mass flux ENSEMBLE
SUFLUXV	kg m-1 s-1	xy	SO4 column v-wind mass flux ENSEMBLE
SO4MASS	kg kg-1	xyz	SO4 Aerosol Mass Mixing Ratio ENSEMBLE
SUEXTTAU	1	xy	SO4 Extinction AOT [550 nm] ENSEMBLE
SUSCATAU	1	xy	SO4 Scattering AOT [550 nm] ENSEMBLE
SUEM001volc	kg m-2 s-1	xy	Sulfate Emission Bin 001 (Volcanic)
SUEM002volc	kg m-2 s-1	xy	Sulfate Emission Bin 002 (Volcanic)
SUEM003volc	kg m-2 s-1	xy	Sulfate Emission Bin 003 (Volcanic)
SUEM004volc	kg m-2 s-1	xy	Sulfate Emission Bin 004 (Volcanic)
SUDP001volc	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 001 (Volcanic)
SUDP002volc	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 002 (Volcanic)
SUDP003volc	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 003 (Volcanic)
SUDP004volc	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 004 (Volcanic)
SUSD001volc	kg m-2 s-1	xy	Sulfate Settling Bin 001 (Volcanic)
SUSD002volc	kg m-2 s-1	xy	Sulfate Settling Bin 002 (Volcanic)
SUSD003volc	kg m-2 s-1	xy	Sulfate Settling Bin 003 (Volcanic)
SUSD004volc	kg m-2 s-1	xy	Sulfate Settling Bin 004 (Volcanic)
SUWT001volc	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 001 (Volcanic)
SUWT002volc	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 002 (Volcanic)
SUWT003volc	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 003 (Volcanic)
SUWT004volc	kg m-2 s-1	xy	Sulfate Wet Deposition Bin 004 (Volcanic)
SUSV001volc	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 001 (Volcanic)
SUSV002volc	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 002 (Volcanic)
SUSV003volc	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 003 (Volcanic)
SUSV004volc	kg m-2 s-1	xy	Sulfate Convective Scavenging Bin 004 (Volcanic)
SO4EMANvolc	kg m-2 s-1	xy	SO4 Anthropogenic Emissions (Volcanic)
SO2EMANvolc	kg m-2 s-1	xy	SO2 Anthropogenic Emissions (Volcanic)
SO2EMBBvolc	kg m-2 s-1	xy	SO2 Biomass Burning Emissions (Volcanic)
SO2EMVNvolc	kg m-2 s-1	xy	SO2 Volcanic (non-explosive) Emissions (Volcanic)
SO2EMVEvolc	kg m-2 s-1	xy	SO2 Volcanic (explosive) Emissions (Volcanic)
PSO2volc	kg m-2 s-1	xyz	SO2 Prod from DMS oxidation (Volcanic)
PMSAvolc	kg m-2 s-1	xyz	MSA Prod from DMS oxidation (Volcanic)
PSO4Gvolc	kg m-2 s-1	xyz	SO4 Prod from SO2 oxidation (Volcanic)
PSO4WETvolc	kg m-2 s-1	xyz	SO4 Prod from wet SO2 oxidation (Volcanic)
PSO4AQvolc	kg m-2 s-1	xyz	SO4 Prod from aqueous SO2 oxidation (Volcanic)
SUPSO2volc	kg m-2 s-1	xy	SO2 Prod from DMS Oxidation [column] (Volcanic)
SUPSO4Gvolc	kg m-2 s-1	xy	SO4 Prod from Gaseous SO2 Oxidation [column] (Volcanic)
SUPSO4AQvolc	kg m-2 s-1	xy	SO4 Prod from Aqueous SO2 Oxidation [column] (Volcanic)

SUPSO4WTvolc	SU	kg m-2 s-1	xy	SO4 Prod from Aqueous SO2 Oxidation (wet dep) [column] (Volcanic)
SUPMSAvolc	SU	kg m-2 s-1	xy	MSA Prod from DMS Oxidation [column] (Volcanic)
SO2SMASSvolc	SU	kg m-3	xy	SO2 Surface Mass Concentration (Volcanic)
SO2CMASSvolc	SU	kg m-2	xy	SO2 Column Mass Density (Volcanic)
SO4SMASSvolc	SU	kg m-3	xy	SO4 Surface Mass Concentration (Volcanic)
SO4CMASSvolc	SU	kg m-2	xy	SO4 Column Mass Density (Volcanic)
DMSSMASSvolc	SU	kg m-3	xy	DMS Surface Mass Concentration (Volcanic)
DMSCMASSvolc	SU	kg m-2	xy	DMS Column Mass Density (Volcanic)
SUCONCvolc	SU	kg m-3	xyz	SO4 Aerosol Mass Concentration (Volcanic)
SUEXTCOEFvolc	SU	m-1	xyz	SO4 Extinction Coefficient [550 nm] (Volcanic)
SUSCACOEFvolc	SU	m-1	xyz	SO4 Scattering Coefficient [550 nm] (Volcanic)
SUANGSTRvolc	SU	1	xy	SO4 Angstrom parameter [470-870 nm] (Volcanic)
SUFLUXUvolc	SU	kg m-1 s-1	xy	SO4 column u-wind mass flux (Volcanic)
SUFLUXVvolc	SU	kg m-1 s-1	xy	SO4 column v-wind mass flux (Volcanic)
SO4MASSvolc	SU	kg kg-1	xyz	SO4 Aerosol Mass Mixing Ratio (Volcanic)
SUEXTTAUvolc	SU	1	xy	SO4 Extinction AOT [550 nm] (Volcanic)
SUSCATAUvolc	SU	1	xy	SO4 Scattering AOT [550 nm] (Volcanic)